SRI KRISHNA INSTITUTIONS
COIMBATORE

PROJECT REPORT

NETWORK ANAMOLY DETECTION

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21BCS045

UNDER THE GUIDANCE OF

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PROJECT DESCRIPTION

SMC Technologies and Software Solutions is a leading technology company renowned for its innovative solutions and exceptional software offerings. With a steadfast commitment to excellence and a customer-centric approach, SMC Technologies has established it self as a trusted partner for businesses seeking cutting-edge technology solutions to address their evolving needs. At the core of SMC Technologies' ethos is a relentless pursuit of innovation.

DEPARTMENT OF COMPUTER SCIENCE

SRI KRISHNA ARTS AND SCIENCE COLLEGE

AN AUTONOMOUS COLLEGE AFFILIATED TO BHARATHIAR UNIVERSITY
Kuniamuthur (P.O), Coimbatore 641008, Tamil Nadu, India

NETWORK ANAMOLY DETECTION

PROJECT REPORT

Submitted in partial fulfilment of the requirements for the award of degree of

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

Submitted by

SHUBHAM BHARAT PATIL

Reg. No:21BCS045

Under the guidance of

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An Autonomous College affiliated to Bharathiar University

COIMBATORE-641 008.

MARCH 2024

SRI KRISHNA INSTITUTIONS COIMBATORE

Sri Krishna Arts And Science College
accredited by NAAC with 'A' grade
Affiliated To Bharathiar University
Kuniamuthur,Coimbatore-641 008.

CERTIFICATE

This is to certify that the project entitled **"NETWORK ANAMOLY DETECTION"** submitted in partial fulfilment of the requirements for the **Degree of Bachelor of Science in Computer Science** to **Sri Krishna Arts and Science College,** an Autonomous College affiliated to Bharathiar University, Coimbatore, is a record of bonafide work carried out by **SHUBHAM BHARAT PATIL (Reg.No. 21BCS045)** under my supervision and guidance, that no part of this Project has been submitted for the award of any other degree or diploma and the work has not been published in popular journal or magazine.

GUIDE 23/5/24

HOD 22/2/2024

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This Project has been submitted for the viva voce conducted on 26/03/24 at Sri Krishna Arts and Science College.

26/3/24

Internal Examiner

26/3

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DECLARATION

I hereby declare that the project entitled **"NETWORK ANAMOLY DETECTION"** submitted to **Sri Krishna Arts and Science College**, an autonomous College affiliated to Bharathiar University, Coimbatore in partial fulfilment of the requirements for the degree of Bachelor of Science in Computer Science is an original work and it has not previously formed the basis for the award of any Degree, Diploma, Associate ship, Fellowship or other similar title to any university or body during the period of my study.

Place: COIMBATORE

Date: **Signature of the Candidate**

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ABSTRACT

In today's digital landscape, ensuring the security and integrity of computer networks is critical endeavor. Network anomaly detection systems play a pivotal role in safeguarding networks against cyber threats by identifying abnormal patterns in network traffic indicative of potential security breaches or malicious activities. This abstract presents a comprehensive overview of network anomaly detection, focusing on the design and implementation of an effective system capable of detecting anomalies in real-time.The first aspect addressed in this abstract is the importance of network anomaly detection in mitigating cybersecurity risks. With the increasing sophistication of cyber threats, traditional security measures are often insufficient to protect networks from advanced attacks. Anomaly detection systems offer a proactive approach to cybersecurity by continuously monitoring network traffic and identifying deviations from normal behavior, thus enabling timely response and mitigation measures.Next, the abstract delves into the key components of a network anomaly detection system. This includes data collection mechanisms to gather network traffic data from various sources such as routers, switches, and firewalls. The extracted data encompasses a range of attributes including packet headers, traffic flow, and other relevant features. Machine learning or statistical models are then deployed to analyze this data and detect anomalies. These models may employ techniques such as unsupervised learning, supervised learning, or semi-supervised learning based on the availability of labeled data.Furthermore, the abstract discusses the challenges involved in designing and implementing an effective anomaly detection system. These challenges stem from the complexity of modern network environments, the vast amount of data generated, and the need for real-time analysis. Scalability, adaptability to diverse network architectures, and accuracy are crucial considerations in developing a robust anomaly detection framework Moreover, the abstract highlights the practical implications of network anomaly detection in enhancing cybersecurity defenses. By successfully detecting and mitigating potential security breaches, anomaly detection systems help organizations safeguard critical assets and infrastructure against cyber threats. Continuous monitoring and analysis of network traffic enable organizations to stay ahead of emerging threats and respond effectively to evolving attack vectors.

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CHAPTER-1

INTRODUCTION

1.1 ABOUT THE ORGANIZATION

SMC Technologies and Software Solutions is a leading technology company renowned for its innovative solutions and exceptional software offerings. With a steadfast commitment to excellence and a customer-centric approach, SMC Technologies has established itself as a trusted partner for businesses seeking cutting-edge technology solutions to address their evolving needs.At the core of SMC Technologies' ethos is a relentless pursuit of innovation. The company's multidisciplinary team of skilled professionals, comprising software engineers, data scientists, and technology enthusiasts, works tirelessly to develop groundbreaking solutions that empower businesses to thrive in the digital age. By staying at the forefront of emerging technologies and trends, SMC Technologies ensures that its clients benefit from the latest advancements in the field.SMC Technologies offers a comprehensive suite of software solutions tailored to meet the diverse requirements of modern businesses. From enterprise resource planning (ERP) systems to customer relationship management (CRM) platforms, and from business intelligence (BI) tools to cloud-based applications, SMC Technologies delivers scalable and customizable solutions that drive operational efficiency, enhance productivity, and foster growth.

One of the hallmarks of SMC Technologies' software solutions is their adaptability and scalability. Recognizing that no two businesses are alike, SMC Technologies designs its solutions with flexibility in mind, allowing for seamless integration with existing infrastructure and the ability to scale up or down as needed. Whether serving small startups or large enterprises, SMC Technologies ensures that its solutions are tailored to fit the unique needs and objectives of each client.SMC Technologies' commitment to quality is reflected in its rigorous software development processes and adherence to industry best practices. The company employs stringent quality assurance measures to ensure that its products meet the highest standards of reliability, performance, and security. By prioritizing quality at every stage of the development lifecycle, SMC Technologies in stills confidence in its clients, enabling them to leverage technology with peace of mind.

1.2 ABOUT THE PROJECT

The network anomaly detection project involves the development and implementation of a system aimed at identifying abnormal activities within a computer network. This system utilizes various techniques such as statistical analysis, machine learning algorithms, and behavioural analysis to detect deviations from normal network behaviour.The project encompasses several key phases, including data collection, preprocessing, feature extraction, model training, and deployment. During the data collection phase, network traffic data is gathered from sensors or network devices. Preprocessing involves cleaning and formatting the data to make it suitable for analysis. Feature extraction techniques are then applied to extract relevant information from the data, such as packet size, protocol type, and timestamps. Machine learning models are trained using labeled data to distinguish between normal and anomalous network behaviour. Finally, the trained models are deployed to monitor live network traffic and raise alerts when anomalies are detected.

The Real-Time Network Anomaly Detection project is a critical endeavour aimed at bolstering network security and performance in today's interconnected digital landscape. By continuously monitoring network traffic in real-time, this project utilizes advanced machine learning algorithms and network analysis techniques to swiftly identify deviations from normal behaviour that could indicate potential security threats or performance issues. Key components of the project include data collection from various network sources, preprocessing to extract relevant features and normalize data, and the deployment of sophisticated anomaly detection algorithms like Isolation Forest and k-means clustering. Upon detecting anomalies, the system triggers real-time alerts, enabling prompt action by network administrators to mitigate potential risks. Visualization tools and reporting mechanisms are integrated to present detected anomalies and network traffic patterns, facilitating informed decision-making and analysis. The project's impact is multifaceted, ranging from bolstered security and enhanced performance to proactive threat response and operational efficiency. Ultimately, the Real-Time Network Anomaly Detection project stands as a crucial initiative in safeguarding network integrity and resilience amidst the ever-evolving landscape of cyber threats and vulnerabilities.

1.3 OBJECTIVE OF THE PROJECT

The objective of the Real-Time Network Anomaly Detection project is multifaceted, aiming to address critical challenges in network security, performance optimization, and operational efficiency. At its core, the project seeks to develop a robust and scalable solution capable of detecting anomalies in network traffic in real-time, thereby enhancing the overall security posture of organizations and ensuring the integrity of digital assets. One of the primary objectives is to proactively identify and mitigate potential security threats, such as malicious activities, unauthorized access attempts, and network intrusions. By leveraging advanced machine learning algorithms and network analysis techniques, the project aims to analyse patterns in network traffic data and swiftly detect deviations from normal behaviour that could indicate suspicious or anomalous activities. This proactive approach to threat detection enables organizations to respond promptly to emerging security threats, minimizing the risk of data breaches, cyberattacks, and other security incidents.

Another key objective of the project is to optimize network performance and efficiency by identifying and addressing performance bottlenecks and anomalies in real-time. By analysing network traffic patterns and identifying sources of latency or congestion, the project aims to help organizations optimize their network infrastructure, improve bandwidth utilization, and enhance overall network performance. This objective is particularly crucial in today's digital landscape, where businesses rely heavily on their network infrastructure to support critical operations and deliver seamless user experiences. By identifying and mitigating performance issues in real-time, the project enables organizations to maintain high levels of availability, reliability, and responsiveness in their network environment ..Additionally, the project aims to enhance operational efficiency and streamline network management processes by automating anomaly detection and alerting mechanisms. By implementing automated workflows and alerting systems, the project reduces the need for manual intervention in network monitoring and management tasks, allowing network administrators to focus their time and resources on more strategic activities. This objective aligns with the broader goal of empowering organizations to operate more efficiently and effectively in today's fast-paced and dynamic business environment. Furthermore, the project aims to facilitate compliance with regulatory requirements and industry standards by ensuring the integrity and security of network infrastructure and data assets.

1.4 PROBLEM STATEMENT

Intrusion detection begins where the firewall ends. Preventing unauthorized entry is best, but not always possible. It is important that the system is reliable and accurate and secure. Intrusion detection is defined as real-time monitoring and analysis of network activity and data for potential Vulnerabilities and attacks in progress. One major limitation of current intrusion detection system (IDS) technologies is the requirement to filter false alarms. IDS is defined as a system that tries to detect and alert of attempted intrusions into a system or a network. IDSs are classified into two major approaches. Intrusion detection is the process of monitoring the events occurring in a computer system or network and analysing them for signs of possible incidents, which are violations or imminent threats of violation of computer security policies, acceptable use policies, or standard security practices. Intrusion prevention is the process of performing intrusion detection and attempting to stop detected possible incidents.

Intrusion Detection and Prevention Systems (IDPS) are primarily focused on identifying possible incidents, logging information about them, attempting to stop them, and reporting them to security administrators. In addition, organizations use IDPSs for other purposes, such as identifying problems with security policies, documenting existing threats and deterring individuals from violating security policies. IDPSs have become a necessary addition to the security infrastructure of nearly every organization. Thus there is necessary to propose a strong detection mechanism to identify attacks. The challenge of network anomaly detection lies in the complexity of modern network environments and the evolving nature of cyber threats. In this context, the problem statement revolves around developing a robust system capable of identifying abnormal patterns within network traffic, indicative of potential security breaches or malicious activities. The objective is to create an anomaly detection framework that can effectively differentiate between normal and anomalous behaviour, enabling timely response and mitigation measures. This entails gathering and analysing network traffic data, extracting relevant features, and deploying advanced machine learning or statistical models to detect deviations from expected behaviour.

1.5 MODULE DESCRIPTION

MODULE DESCRIPTION

- User module
- Admin module
- Detection module
- Reporting module
- Trusted module

USER MODULE

The User Module facilitates user interaction with the network anomaly detection system, offering features such as user authentication, account management, and access to system resources. Users can customize their preferences, view alerts and notifications, and access reports and dashboards relevant to their roles and responsibilities.

ADMIN MODULE

The Admin Module serves as the central management interface for the network anomaly detection system, providing administrators with the tools and capabilities to configure, monitor, and manage the system effectively. Key features include user management, role-based access control, system configuration, and logging and auditing functionalities.

DETECTION MODULE

The Detection Module is responsible for analysing network traffic and detecting anomalies or suspicious activities in real-time. It incorporates advanced algorithms, machine learning models, and behavioural analysis techniques to identify deviations from normal network behaviour, enabling proactive threat detection and response

Reporting module

The Reporting Module generates comprehensive reports and summaries of network activity, security incidents, and performance metrics. It offers customizable reporting templates, visualization tools, and scheduling options, allowing administrators to generate and share insights with stakeholders and regulatory authorities

Trusted module

The Trusted Module maintains a repository of trusted entities within the network environment, including trusted hosts, devices, and network segments. It enables administrators to define policies and rules for trusted entities, ensuring that legitimate network traffic is accurately identified and distinguished from potential security threats.

CHAPTER-2

SYSTEM SPECIFICATION

2.1 HARDWARE SPECIFICATION

- HARD DISK : 320 GB
- MONITOR :15 VGA colour
- MOUSE :Logitech.
- RAM :4 GB
- KEYBOARD :110 keys enhance
- PROCESSOR :intel corei3

2.2 SOFTEWRE SPECIFICATION

- Operating system : Windows 10
- Coding Language : Python 3.8
- Web Framework : Flask

2.3 SOFTWARE DESCRIPTION

python

Python is a high-level, interpreted programming language known for its simplicity, versatility, and ease of use. Developed in the late 1980s by Guido van Rossum, Python has grown to become one of the most popular languages in various domains, including web development, data science, artificial intelligence, scientific computing, and network programming. At its core, Python emphasizes readability and simplicity, with a clean and concise syntax that makes it accessible to beginners and experienced developers alike. The language features dynamic typing and automatic memory management, allowing developers to focus on solving problems rather than managing low-level details.

Python's extensive standard library provides a rich set of modules and functions for performing a wide range of tasks, from file I/O and networking to data processing and manipulation. Additionally, Python's vibrant ecosystem of third-party libraries and frameworks, such as NumPy, pandas, TensorFlow, Django, Flask, and scikit-learn, further extends its capabilities and enables developers to build complex and scalable applications with ease.

Python's versatility makes it well-suited for various programming paradigms, including procedural, object-oriented, and functional programming. Developers can choose the most appropriate paradigm for their specific use case, allowing for flexibility and adaptability in software design and development One of Python's key strengths lies in its support for rapid prototyping and development. Its interactive interpreter, known as the Python REPL (Read-Eval-Print Loop), enables developers to experiment with code snippets, test ideas, and iterate quickly, fostering a productive development work flow. Furthermore, Python's cross-platform compatibility ensures that code written in Python can run seamlessly on different operating systems, including Windows, macOS, and Linux, without requiring any modifications. This portability makes Python an ideal choice for developing platform-independent applications and tools. Python's community-driven development model fos\ters collaboration, innovation, and knowledge sharing among developers worldwide. The Python Software Foundation (PSF) oversees the development and maintenance of the language, ensuring its continued growth and evolution through regular updates and releases.

Scikit-learn

Scikit-learn is a versatile and powerful machine learning library in Python designed to facilitate the development and implementation of machine learning algorithms for various tasks such as classification, regression, clustering, and dimensionality reduction. With a rich set of features and user-friendly interface, Scikit-learn provides a comprehensive toolkit for both novice and experienced machine learning practitioners to explore, experiment, and deploy machine learning models effectively. At its core, Scikit-learn offers a wide range of supervised and unsupervised learning algorithms, including linear and logistic regression, support vector machines (SVM), decision trees, random forests, k-nearest neighbors (KNN), k-means clustering, and principal component analysis (PCA), among others. These algorithms are implemented with efficiency and scalability in mind, allowing for seamless integration into data science workflows and applications of varying scales.

One of the key strengths of Scikit-learn lies in its simplicity and ease of use. The library provides a consistent and intuitive API that makes it easy to experiment with different algorithms, tune hyperparameters, and evaluate model performance using cross-validation techniques. Additionally, Scikit-learn offers extensive documentation, tutorials, and examples, enabling users to quickly get up to speed with machine learning concepts and technique .Scikit-learn also provides a range of utilities and functionalities to support the entire machine learning pipeline, from data preprocessing and feature extraction to model evaluation and deployment. Preprocessing tools include functions for scaling, normalization, imputation, and feature selection, allowing users to prepare their data for modeling efficiently. Feature extraction techniques such as bag-of-words, TF-IDF, and word embeddings are also supported, enabling users to extract meaningful features from raw data effectively. Furthermore, Scikit-learn offers tools for model evaluation and validation, including metrics for classification (e.g., accuracy, precision, recall, F1-score), regression (e.g., mean squared error, R-squared), and clustering (e.g., silhouette score). Cross-validation techniques such as k-fold cross-validation and stratified sampling are readily available, facilitating robust model evaluation and selection. Scikit-learn's compatibility with other Python libraries and frameworks further enhances its utility and flexibility

Snort

Snort, an open-source network intrusion detection and prevention system, stands as a stalwart defender against cyber threats, known for its robust features and real-time threat detection capabilities. Developed initially by Sourcefire and now part of Cisco, Snort has earned widespread recognition for its ability to safeguard networks from a myriad of security risks. At its core, Snort employs packet sniffing techniques to monitor network traffic, analyzing data packets in real-time to identify suspicious activities and potential security breaches. Its signature-based detection engine, complemented by protocol analysis and anomaly detection methods, enables the system to detect known threats and identify deviations from standard network protocols, thus providing comprehensive protection against emerging threats and zero-day attacks. A hallmark of Snort is its flexibility and customization options. Network administrators can tailor Snort's detection rules to suit their organization's specific security requirements, allowing for fine-tuning of threat detection parameters and response mechanisms. This flexibility extends to its modular architecture, which facilitates seamless integration with third-party plugins and extensions, enabling users to extend Snort's functionality and adapt it to evolving security needs. Moreover, Snort's logging and alerting capabilities provide network administrators with timely notifications of detected security events, empowering them to respond swiftly and effectively to potential threats.

In addition to its technical prowess, Snort benefits from a vibrant community of users and developers who contribute to its ongoing development and support. This active community ecosystem ensures that Snort remains up-to-date with the latest threats and vulnerabilities, with continuous improvements and updates rolled out regularly. Furthermore, Snort's integration with Security Information and Event Management (SIEM) systems enables centralized log management and correlation, facilitating comprehensive analysis of security events across the network. As cyber threats continue to evolve and proliferate, Snort remains a trusted ally in the ongoing battle for network security. Its proven track record, combined with its adaptability, community support, and real-time threat detection capabilities, positions Snort as a cornerstone of network defense strategies for organizations worldwide. By leveraging Snort's powerful features and proactive approach to threat detection, organizations can fortify their network infrastructure, mitigate security risks, and safeguard their digital assets against the ever-present threat of cyber attacks.

Features

• Real-time traffic monitor.

• Packet logging.

• Analysis of protocol.

• Content matching.

• OS fingerprinting.

• Can be installed in any network environment.

• Creates logs.

• Open Source.

• Rules are easy to implement.

Snort's open source network-based intrusion detection/prevention system (IDS/IPS) has the ability to perform real-time traffic analysis and packet logging on Internet Protocol (IP) networks. Snort performs protocol analysis, content searching and matching. The program can also be used to detect probes or attacks, including, but not limited to, operating system fingerprinting attempts, semantic URL attacks, buffer overflows, server message block probes, and stealth port scans.

Snort can be configured in three main modes:

- Sniffer mode
- Packet Logger
- Network Intrusion Detection

Sniffer mode

Sniffer mode in network security refers to a passive method of monitoring network traffic without actively interfering with or modifying it. In this mode, a network sniffer, such as Wireshark or tcpdump, captures packets traversing the network segment to which it is connected. Unlike active scanning techniques, which involve sending packets to probe network devices for vulnerabilities or information, sniffer mode operates by simply observing and recording packets as they pass through the network.

The primary purpose of sniffer mode is to analyze network traffic for troubleshooting, security monitoring, or performance optimization purposes. By passively monitoring network traffic, security professionals can gain insights into the behavior of network devices,

Packet logger

A packet logger is a network tool used to capture and log network packets passing through a network interface. Unlike a network sniffer, which analyse. packets in real-time, a packet logger stores captured packets to a file for later analysis. Packet loggers are commonly used for network troubleshooting, security monitoring, and forensic analysis.Packet loggers capture packets at the data link layer of the OSI model, allowing them to record all network traffic, including Ethernet frames, IP packets, and TCP/UDP segments. This comprehensive packet capture provides valuable insights into network activity, allowing administrators to identify and analyze network issues, detect security threats, and investigate network incidents.

One of the key advantages of packet loggers is their ability to capture and store large volumes of network traffic over extended periods. This makes them particularly useful for long-term network monitoring and forensic analysis, where historical packet data may be critical for identifying security breaches or performance issues. A packet logger is a network tool used to capture and log network packets passing through a network interface. Unlike a network sniffer, which analyzes packets in real-time, a packet logger stores captured packets to a file for later analysis. Packet loggers are commonly used for network troubleshooting, security monitoring, and forensic analysis.Packet loggers can be deployed on individual hosts, network appliances, or dedicated network monitoring devices. They typically operate passively, capturing packets as they traverse the network without introducing additional latency or overhead. Additionally, packet loggers may support advanced features such as packet filtering, packet slicing, and timestamping, enhancing their utility for network analysis and troubleshooting.

It is a crucial component of cybersecurity, aimed at identifying abnormal patterns or deviations from expected behavior within network traffic. This technique leverages advanced algorithms and machine learning models to analyze network data in real-time, detecting anomalies that may indicate potential security breaches, malicious activities, or performance issues. By continuously monitoring network traffic, anomaly detection systems can identify various types of anomalies, including sudden spikes in network traffic, unusual communication patterns, unauthorized access attempts, or malicious activity such as denial-of-service attacks or network intrusions. Once anomalies are detected, appropriate actions can be taken, such as alerting network administrators, implementing security controls, or initiating incident response procedures. Network anomaly detection plays a critical role in enhancing network security, protecting against cyber threats, and ensuring the integrity and availability of network resources**.**

Configuring Snort into Sniffer Mode

/snort –v - Prints TCP/IP/UDP/ICMP packet headers to the Screen.

/snort –vd -Instructs Snort to display the packet data as well as the headers.

Configuring Snort into Packet Logger Mode

/snort –dev –l ./name_of_the_log_directory

Records the packets to the disk.

/snort –l ./name_of_ the_log_directory –b

Binary Mode logs the packets into tcp dump format to a single binary file in the logging directory.

Configuring Snort into Network anamoly detection mode

snort –dev –l ./log –h 192.168.1.0/24 –c snort.conf (snort.conf is the snort configuration file) This command will apply the rules configured in the snort.conf file to each packet to decide if an action based upon the rulr type in the file should be taken. If we don't specify any output directory for the program, it will default to /var/log/snort

- -A fast: Fast Alert Mode. Writes the alert in simple format with a timestamp, alert message, source and destination IPs/ports
- A full Full Alert Mode. This is the default alert mode and will be used automatically if you do not specify a mode. –
- A none Turns off alerting. –
- A console Sends "fast-style" alerts to Console (Screen).
- -A unsock Sends alerts to a UNIX socket that another program can listen on

High performance configuration in Snort

snort –b –A fast –c snort.conf This command will log packets in tcpdump format and produce minimal alerts.

Snort Modes

Snort can operate in three different modes namely-

- Inline
- passive

Inline

When Snort is in Inline mode, it acts as an IPS (Intrusion Prevention System) allowing drop rules to trigger.

Passive

When Snort is in Passive mode, it acts as an IDS (Intrusion Detection System). Drop rules are not loaded.

Npcap

Npcap is the Nmap Project's packet sniffing (and sending) library for Windows. It is based on the discontinued Winpcap library, but with improved speed, portability, security, and efficiency. In particular, Npcap offers:

WinPcap for Windows 10: Npcap works on Windows 7 and later by making use of the new NDIS 6 Light-Weight Filter (LWF) API. It's faster than the deprecated NDIS 5 API, which Microsoft could remove at any time. Also, the driver is signed with our EV certificate and countersigned by Microsoft, so it works even with the stricter driver signing requirements in Windows 10 1607. • Extra Security: Npcap can (optionally) be restricted so that only Administrators can sniff packets. If a non-Admin user tries to utilize Npcap through software such as Nmap or Wireshark, the user will have to pass a User Account Control (UAC) dialog to utilize the driver. This is conceptually similar to UNIX, where root access is generally required to capture packets. We've 24 also enabled the Windows ASLR and DEP security features and signed the driver, DLLs, and executables to prevent tampering. Loopback Packet Capture: Npcap is able to sniff loopback packets (transmissions between services on the same machine) by using the Windows Filtering Platform (WFP).

Chapter-3

SYSTEM STUDY

3.1 EXISTING SYSTEM

Computer forensics science, which views computer systems as crime scenes, aims to identify, preserve, recover, analyse, and present facts and opinions on information collected for a security 25 event. It analyses what attackers have done such as spreading computer viruses, malwares, and malicious codes and conducting DDoS attacks(Distributed denial of service (DDoS)). In the existing system for intrusion detection, conventional methods often rely on signature-based techniques and rule sets to identify known patterns of malicious activities within a network. These systems use predefined rules and databases of known attack signatures to recognize and respond to specific threats. While this approach is effective against well-established and documented attacks, it tends to struggle with the detection of novel or previously unseen threats. Furthermore, traditional intrusion detection systems may produce a significant number of false positives and false negatives, leading to operational challenges for network administrators.

3.1.1 LIMITATION OF EXISTING SYSTEM

Existing network anomaly detection systems face several limitations that impede their effectiveness in safeguarding against evolving cyber threats. One significant constraint lies in their reliance on signature-based detection methods, which are only capable of identifying known patterns of malicious activity. This approach proves inadequate against novel and previously unseen threats, such as zero-day attacks, leaving systems vulnerable to exploitation. Additionally, these systems often struggle with false positives, inaccurately flagging legitimate network activities as anomalies and inundating administrators with alerts, which can lead to alert fatigue and reduced responsiveness to genuine threats.Moreover, the scalability of existing systems poses a challenge, particularly in environments with high volumes of network traffic. As network traffic continues to grow in complexity and magnitude, traditional anomaly detection systems may struggle to analyse and process data effectively, resulting in performance degradation and decreased detection accuracy. Furthermore, the diversity of modern network architectures and protocols complicates the adaptability of existing detection mechanisms, as they may not adequately cover all potential attack vectors or account for variations in network behaviour across different environments**.**

3.1.2 DISADVANTAGES OF EXISTING SYSTEM

The network anomaly detection exhibits several disadvantages that hinder its effectiveness in identifying and mitigating security threats. One major drawback is its reliance on signature-based detection methods, which are limited in their ability to detect novel or unknown threats. Signature-based systems operate by comparing network traffic patterns against a predefined database of known attack signatures. However, they often struggle to detect previously unseen attacks or sophisticated evasion techniques employed by modern cyber threats.Furthermore, the existing system may suffer from a high rate of false positives, where benign network activity is incorrectly flagged as anomalous or malicious. False positives can overwhelm security analysts with a large volume of irrelevant alerts, leading to alert fatigue and potentially causing critical security incidents to be overlooked or ignored. This inefficiency in alert prioritization and response can significantly impact the system's overall effectiveness in detecting genuine security threats.

Another limitation of the existing system is its lack of scalability and adaptability to evolving network environments and attack techniques. Traditional network anomaly detection systems may struggle to keep pace with the increasing volume and complexity of network traffic, leading to performance degradation and decreased detection accuracy. Additionally, these systems may lack the flexibility to quickly adapt to new threats or changes in network infrastructure, resulting in gaps in security coverage and increased vulnerability to emerging threats.Moreover, the reliance on centralized detection architectures in the existing system can introduce single points of failure and scalability bottlenecks. Centralized detection systems often rely on a limited number of sensors or monitoring points to analyze network traffic, making them susceptible to overload during periods of high traffic volume or targeted attacks. This can result in delays in anomaly detection and response, allowing attackers to exploit vulnerabilities and escalate their activities before countermeasures can be deployed.

3.2 PROPOSED SYSTEM

The proposed system for network anomaly detection aims to overcome the limitations of existing approaches by leveraging advanced techniques and methodologies to enhance the detection and mitigation of emerging cyber threats. At its core, the proposed system integrates cutting-edge machine learning algorithms, artificial intelligence, and behavioural analysis techniques to provide a comprehensive and proactive approach to network security.One of the key features of the proposed system is its adoption of anomaly detection algorithms that go beyond traditional signature-based methods. By utilizing machine learning models such as deep learning neural networks, unsupervised learning techniques, and ensemble methods, the system can identify anomalies in network traffic that may signify malicious activity, even in cases where traditional approaches fall short. These advanced algorithms analyse patterns, trends, and deviations in network behaviour, allowing the system to detect previously unseen threats, including zero-day attacks and sophisticated cyber threats.

Furthermore, the proposed system incorporates artificial intelligence capabilities to enhance the accuracy and efficiency of anomaly detection. By leveraging AI-driven algorithms, the system can dynamically adapt to evolving threats and network conditions, continuously learning and refining its detection capabilities over time. This adaptive approach enables the system to stay ahead of emerging cyber threats, providing organizations with proactive defense mechanisms against a wide range of attacks.analysis plays a crucial role in the proposed system, allowing it to identify anomalous behaviour based on deviations from normal network patterns. By establishing baseline profiles of normal network activity, the system can detect deviations that may indicate potential security breaches or unauthorized access attempts. Behavioral analysis techniques such as cluster analysis, time series analysis, and anomaly scoring algorithms enable the system to differentiate between legitimate network traffic and suspicious activities, reducing false positives and enhancing the accuracy of threat detection.Moreover, the proposed system emphasizes real-time monitoring and response capabilities to enable rapid detection and mitigation of security threats. By continuously monitoring network traffic in real-time, the system can detect anomalies as they occur and trigger immediate responses, such as generating alerts, blocking suspicious traffic, or initiating incident response procedures. This proactive approach to threat detection minimizes the impact of security incidents and enables organizations to respond swiftly to emerging threats.

3.2.1 ADVANTAGES OF PROPOSED SYSTEM

Enhanced Detection Accuracy: The use of an Improved CNN allows the system to learn and identify complex patterns in network traffic, improving its accuracy in detecting both known and previously unseen threats. This results in a more robust and effective intrusion detection mechanism.

Adaptability to Evolving Threats: 27 Unlike signature-based systems, the proposed IDS with Improved CNN is better equipped to adapt dynamically to evolving cyber threats. The deep learning model can continuously update its understanding of new attack patterns without requiring manual rule adjustments, making it more resilient against sophisticated and polymorphic attacks.

Reduced False Positives: The advanced machine learning capabilities of the Improved CNN contribute to a significant reduction in false positives. By learning from a diverse range of network traffic patterns, the system can differentiate between normal behavior and potential intrusions more accurately, minimizing unnecessary alerts

Scalability: The proposed system is designed to be scalable, allowing it to handle the increasing volume and complexity of network traffic. This scalability ensures that the IDS can effectively operate in various network environments, from small-scale networks to large, complex infrastructures.

Automation and Real-time Response: With the ability to analyze network traffic in real-time, the proposed system facilitates faster detection and response to security incidents. Automation features can enable immediate actions, such as blocking suspicious activities or isolating affected areas of the network, reducing the response time to potential threats.

CHAPTER-4

SYSTEM DESIGN

4.1 INPUT DESIGN

Input design plays a crucial role in the development of any software system, including network anomaly detection systems. It encompasses the process of collecting, organizing, and validating data inputs to ensure that the system can effectively perform its intended functions. In the context of network anomaly detection, input design involves defining the types of data sources, formats, and protocols that the system will utilize to capture and analyze network traffic.One aspect of input design is determining the sources of network data that the system will monitor. This may include network devices such as routers, switches, and firewalls, as well as network sensors, packet captures, and log files. Each data source provides valuable insights into network activity and potential security threats, and it's essential to identify and prioritize the sources that are most relevant to the organization's security objectives.

Once the data sources have been identified, the next step in input design is defining the formats and protocols for capturing and transmitting network data. This includes specifying the network protocols (e.g., TCP/IP, UDP) and data formats (e.g., packet headers, payload content) that the system will support. Additionally, input design involves determining the mechanisms for collecting and aggregating network data, such as network taps, port mirroring, or agent-based sensors.Another crucial aspect of input design is data preprocessing, which involves transforming and normalizing raw network data into a format that is suitable for analysis. This may include parsing packet headers, extracting relevant features, and applying data transformation techniques to clean and standardize the data. Data preprocessing helps ensure the accuracy and reliability of the input data and facilitates more effective analysis and detection of network anomalies.Furthermore, input design encompasses the validation and verification of input data to ensure its integrity and authenticity. This may involve implementing mechanisms for data validation, such as checksums, digital signatures, or cryptographic hashes, to verify the integrity of network data and detect any unauthorized modifications or tampering.

4.2 OUTPUT DESIGN

Output design is a crucial aspect of software development, including network anomaly detection systems, as it determines how information is presented to users and stakeholders. In the context of network anomaly detection, effective output design is essential for providing actionable insights, facilitating decision-making, and enabling timely responses to security threats. Output design encompasses various elements, including data visualization, reporting, alerting mechanisms, and user interfaces, all of which play a vital role in conveying information and enhancing the usability of the system.One key aspect of output design is data visualization, which involves presenting complex network data and analysis results in a visually intuitive and informative manner. Data visualization techniques such as charts, graphs, heatmaps, and timelines can help users understand network traffic patterns, identify anomalies, and visualize the impact of security incidents. By representing data visually, network anomaly detection systems can enhance situational awareness, enabling users to quickly grasp the significance of detected anomalies and take appropriate action.

Moreover, output design encompasses the generation of reports and summaries that provide detailed insights into network activity, security incidents, and performance metrics. These reports may include information such as the types and frequencies of detected anomalies, trends in network traffic, security posture assessments, and recommendations for mitigating security risks. By providing comprehensive reports, network anomaly detection systems enable stakeholders to assess the effectiveness of security measures, track performance over time, and make informed decisions to improve network security and resilience.Additionally, output design involves implementing alerting mechanisms to notify users and administrators of detected anomalies or security events in real-time. Alerting mechanisms may include email alerts, SMS notifications, dashboard alerts, and integration with third-party incident response platforms. By issuing timely alerts, network anomaly detection systems enable users to respond swiftly to security threats, initiate incident response procedures, and mitigate potential risks before they escalate.Furthermore, output design encompasses the design of user interfaces that facilitate interaction with the system and enable users to access and analyze network data effectively. User interfaces should be intuitive, user-friendly, and responsive, allowing users to navigate through the system, visualize data, customize settings, and configure alerts easily.

4.3 DATA BASE DESIGN

Database design is a critical aspect of building a robust and efficient system, ensuring data organization, integrity, and accessibility. When designing a database for a network anomaly detection system, several considerations should be taken into account to effectively store, manage, and analyse large volumes of network traffic data.

Database Model Selection: Choose the appropriate database model based on the system requirements and data characteristics. Options include relational databases (e.g., MySQL, PostgreSQL) for structured data, NoSQL databases (e.g., MongoDB, Cassandra) for unstructured or semi-structured data, or a combination of both to leverage the strengths of each model.

Schema Design: Design the database schema to reflect the structure of the data and support efficient querying and analysis. This involves defining tables, columns, and relationships between entities. For a network anomaly detection system, tables may include:

Normalization: Apply normalization techniques to minimize redundancy and ensure data consistency and integrity. Normalize the database schema to at least third normal form (3NF) to avoid data anomalies and maintain data quality.

indexing: Create indexes on key fields to optimize query performance and speed up data retrieval. Identify frequently queried fields and create indexes to improve search efficiency.

4.3 TABLE DESIGN

Database design for a network anomaly detection system is crucial for efficiently storing, managing, and analyzing large volumes of network traffic data. The database schema should be designed to accommodate various types of data, including raw network packets, processed features, alerts, and metadata, while ensuring scalability, performance, and data integrity.

At the core of the database design is the choice of database model, with options including relational, NoSQL, or a combination of both, depending on the specific requirements

TRAFFIC DATA TABLE

Column Name	Data Type	Description
traffic_id	INTEGER	Primary key for traffic records
timestamp	TIMESTAMP	Timestamp of traffic occurrence
source_ip	VARCHAR(15)	Source IP address of the traffic
destination_ip	VARCHAR(15)	Destination IP address of traffic
protocol	VARCHAR(10)	Network protocol (e.g., TCP, UDP)
port	INTEGER	Port number
packet_size	INTEGER	Size of the packet in bytes
status	VARCHAR(10)	Status of traffic (normal/anomaly)
anomaly_type	VARCHAR(50)	Type of anomaly detected

USER TABLE

Column Name	Data Type	Description
user_id	INTEGER	Primary key for user records
username	VARCHAR(50)	Username of the network user
role	VARCHAR(20)	Role of the user in the network
department	VARCHAR(50)	Department to which the user belongs

ANAMOLY LOG TABLE

Column Name	Data Type	Description
log_id	INTEGER	Primary key for anomaly logs
traffic_id	INTEGER	Foreign key referencing traffic_id
user_id	INTEGER	Foreign key referencing user_id
timestamp	TIMESTAMP	Timestamp of anomaly detection
anomaly_type	VARCHAR(50)	Type of anomaly detected
description	TEXT	Description of the anomaly

.

CHAPTER-5

SYSTEM TESTING

5.1 TESTING

TYPES OF TESTING

- Functional testing
- Performance testing
- Security testing
- Reliability testing
- Usability testing
- Regression testing

5.1.1 FUNCTIONAL TESTING

It verifies that each function of the system operates according to specifications. Performance testing evaluates system responsiveness and stability under varying loads. Security testing assesses the system's ability to protect data and resources from unauthorized access and attacks. Reliability testing ensures the system operates consistently without failures. Usability testing measures user satisfaction and ease of system use. Regression testing confirms that recent changes haven't adversely affected existing functionalities. Each testing type plays a crucial role in ensuring the quality, reliability, and security of the network anomaly detection system.

5.1.1 PERFORMANCETESTING

Performance testing evaluates the system's responsiveness, scalability, and stability under different conditions, including varying loads and stress levels. It measures response times, throughput, and resource utilization to identify bottlenecks and optimize system performance. By simulating real-world scenarios, performance testing ensures the system can handle expected user traffic without degradation, providing a smooth and reliable user experience. Additionally, it helps determine system capacity, scalability limits, and areas for optimization to enhance overall system efficiency and reliability.

5.1.3 SECURITY TESTING

Security testing assesses the system's ability to protect data, resources, and functionality from unauthorized access, attacks, and vulnerabilities. It encompasses various techniques such as penetration testing, vulnerability scanning, and security audits to identify potential weaknesses and threats. Security testing aims to uncover vulnerabilities in the system's architecture, configurations, and code, helping to mitigate risks and prevent security breaches. By identifying and addressing security flaws proactively, security testing ensures the confidentiality, integrity, and availability of the network anomaly detection system, safeguarding sensitive information and mitigating potential threats from malicious actors.

5.1.4 RELIABILITY TESTING

Reliability testing evaluates the system's ability to consistently perform its functions accurately and effectively under normal and stressful conditions. It focuses on identifying and mitigating potential failures, errors, and crashes that may occur during operation. By subjecting the system to various stressors, such as heavy loads, extended usage, and adverse environments, reliability testing helps ensure uninterrupted operation and resilience against failures. This testing type aims to build user trust by confirming the system's stability, robustness, and availability, ultimately enhancing its reliability and minimizing the risk of downtime or performance degradation in production environments.

5.1.5 USABILITY TESTING

Usability testing evaluates the system's ease of use, intuitiveness, and user satisfaction by observing real users as they interact with the system. It focuses on identifying usability issues, such as navigation challenges, confusing interfaces, and unclear instructions, to improve the overall user experience. Usability testing involves tasks such as scenario-based testing, heuristic evaluation, and user feedback collection to gather insights into how users perceive and interact with the system. By addressing usability issues early in the development process, usability testing ensures that the system meets user needs, enhances user productivity, and promotes user satisfaction, ultimately leading to higher adoption rates and user engagement.

5.1.6 REGRESSION TESTING

Regression testing verifies that recent changes or updates to the system haven't adversely affected existing functionalities. It involves retesting previously tested features and functionalities to ensure they still perform as expected after modifications. Regression testing aims to detect any unintended side effects or regressions introduced by new code changes, bug fixes, or system updates. By validating the stability and integrity of the system across different versions and iterations, regression testing helps maintain software quality and reliability over time. It is essential for preventing the reintroduction of previously fixed issues and ensuring the overall consistency and functionality of the network anomaly detection system.

CHAPTER-6

6.1 SYSTEM IMPLEMENATION

System implementation is a crucial phase in the development lifecycle of a network anomaly detection system, where the designed solution is put into practice to achieve the desired objectives. This phase involves the actual deployment, configuration, testing, and integration of the system components to ensure its functionality, reliability, and effectiveness in real-world environment.The implementation process typically begins with the deployment of hardware and software infrastructure necessary to support the network anomaly detection system. This includes installing and configuring servers, network appliances, and other hardware components required for data capture, processing, and analysis. Additionally, the necessary software components, including the network anomaly detection application, database management systems, and supporting tools, are installed and configured according to the system requirements.Once the infrastructure is in place, the next step is to configure the network anomaly detection system according to the specific needs and objectives of the organization. This involves setting up monitoring policies, defining detection rules, configuring alerting mechanisms, and integrating with existing security infrastructure such as firewalls, intrusion detection systems, and SIEM platforms. Configuration tasks may also include customizing dashboards, reports, and user interfaces to align with organizational preferences and requirements.After the configuration phase, thorough testing is conducted to ensure the proper functionality and performance of the network anomaly detection system. This includes functional testing to verify that all system components and features operate as expected, performance testing to assess system responsiveness and scalability, security testing to identify and mitigate potential vulnerabilities, and usability testing to evaluate user interaction and satisfaction.

Once testing is complete and the system is deemed ready for production, the implementation process transitions to deployment and integration with the organization's network infrastructure. This involves deploying the system in the production environment, configuring network devices and sensors to capture and forward network traffic to the detection system, and integrating with existing security tools and platforms to facilitate centralized management and correlation of security events.

6.2 SYSTEM MAINTENANCE

System maintenance is a critical aspect of ensuring the ongoing functionality, reliability, and security of a network anomaly detection system. It involves a set of activities and processes aimed at monitoring, updating, optimizing, and troubleshooting the system to keep it operating at peak performance and effectiveness over time.The maintenance process begins with routine monitoring and health checks to assess the system's status and performance. This includes monitoring key performance metrics such as CPU and memory utilization, network traffic patterns, and system uptime to identify any abnormalities or issues that may impact system operation. Monitoring tools and dashboards are used to provide real-time visibility into system health and performance, enabling administrators to proactively address any issues that arise.

Regular software updates and patches are essential to address security vulnerabilities, bugs, and performance optimizations. System administrators must stay abreast of vendor releases and security advisories to ensure timely application of updates and patches. Patch management processes should be implemented to schedule and deploy updates without disrupting system availability or introducing new issues. Additionally, software updates may include new features or enhancements that improve system functionality and effectiveness.Performance optimization is another key aspect of system maintenance, aimed at improving system efficiency, responsiveness, and scalability. This may involve tuning system configurations, optimizing resource allocation, and fine-tuning detection algorithms to enhance system performance under varying loads and conditions. Performance testing and analysis tools can be used to identify bottlenecks and areas for improvement, allowing administrators to implement optimizations to enhance overall system performance.Security maintenance is of paramount importance to ensure the ongoing protection of the network anomaly detection system and the underlying infrastructure. This includes regular security assessments, vulnerability scanning, and penetration testing to identify and mitigate potential security risks and vulnerabilities. Security policies and procedures should be established and enforced to ensure compliance with industry standards and regulatory requirements. Additionally, access controls, encryption, and other security measures should be implemented to protect sensitive data and resources from unauthorized access and attacks.Regular backups and disaster recovery planning are essential components of system maintenance to ensure data integrity and business continuity in the event of system failures or security incidents. Backups should be performed regularly and stored securely off-site to protect against data loss due to hardware failures, malware infections, or other unforeseen events.

CHAPTER-7

CONCLUSION

In the dynamic landscape of cybersecurity, the implementation and maintenance of a network anomaly detection system play a pivotal role in fortifying defenses against evolving threats. Through meticulous planning, diligent execution, and continuous vigilance, organizations can establish a robust framework to identify and mitigate abnormal network behaviors, thereby safeguarding critical digital assets and information. The journey begins with strategic planning, where organizations define their objectives, assess their infrastructure, and outline requirements for the anomaly detection system. With clear goals in mind, the design phase focuses on crafting a scalable and adaptable architecture that leverages advanced techniques such as statistical analysis, machine learning algorithms, and behavioral analysis to detect deviations from normal network behavior.

As the implementation unfolds, thorough testing ensures the reliability and accuracy of the system, minimizing the risk of false positives and false negatives. Rigorous testing scenarios simulate various real-world conditions, validating the system's effectiveness in detecting anomalies while minimizing disruptions to normal network operations. Upon deployment, the system transitions into the maintenance phase, where continuous monitoring and adaptation are essential. Regular updates, patches, and enhancements keep the system resilient against emerging threats and evolving network environments. Ongoing analysis of detected anomalies refines detection algorithms, improving the system's ability to discern between benign and malicious activities

CHAPTER-8

FUTURE ENCHANCEMENT

The network anomaly detection system may include advancements in several key areas to address emerging threats, improve detection capabilities, and enhance overall system performance and reliability. One significant area of future enhancement involves the integration of artificial intelligence (AI) and machine learning (ML) technologies to enable more sophisticated anomaly detection algorithms and predictive analytics. By leveraging AI and ML techniques, such as deep learning and neural networks, the system can autonomously learn from historical data, adapt to evolving threats, and identify subtle anomalies that may go undetected by traditional methods. This enhancement would lead to more accurate and timely detection of security threats, reducing false positives and enhancing the overall effectiveness of the system.Additionally, future enhancements may focus on enhancing the scalability and performance of the network anomaly detection system to accommodate the growing volume and complexity of network traffic. This could involve the development of distributed architectures, cloud-based deployments, and optimized processing algorithms to enable the system to handle large-scale network environments and high-speed data streams more efficiently. By improving scalability and performance, the system can effectively scale to meet the needs of organizations with diverse network infrastructures and evolving security requirements.

Furthermore, future enhancements may prioritize the integration of threat intelligence feeds, advanced analytics, and automated response capabilities to enable proactive threat hunting and incident response. By integrating with external threat intelligence sources, such as industry-specific threat feeds, open-source intelligence (OSINT), and threat intelligence platforms (TIPs), the system can enhance its visibility into emerging threats and known attack vectors, enabling preemptive action to mitigate risks before they escalate. Automated response capabilities, such as threat blocking, quarantine, and remediation, can further enhance the system's ability to respond to security threats in real-time, reducing the time to detect and mitigate security incidents.Another area of future enhancement may involve the development of more user-friendly interfaces, intuitive dashboards, and advanced visualization tools to empower security analysts and administrators to quickly and effectively analyze network traffic, identify trends, and make informed decisions.

CHAPTER-9

9.1 BOOK REFERENCES

1. "Network Intrusion Detection: An Analyst's Handbook" by Stephen Northcutt, Judy Novak, Paul A. Van Oorschot, and Lance Spitzner

2. "Intrusion Detection Systems" by Rebecca Gurley Bace

3. "Applied Network Security Monitoring: Collection, Detection, and Analysis" by Chris Sanders, Jason Smith

4. "Network Security Essentials: Applications and Standards" by William Stallings

5. "Practical Packet Analysis: Using Wireshark to Solve Real-World Network Problems" by Chris Sanders

6. "The Practice of Network Security Monitoring: Understanding Incident Detection and Response" by Richard Bejtlich

9.2 WEB REFERENCES

1. MITRE ATT&CK Framework: A comprehensive knowledge base of adversary tactics and techniques, including those related to network-based attacks. Website: [MITRE ATT&CK Framework](https://attack.mitre.org/)

2. SANS Institute: Offers a wide range of cybersecurity resources, including articles, whitepapers, and webcasts on network intrusion detection and anomaly detection. Website: [SANS Institute](https://www.sans.org/)

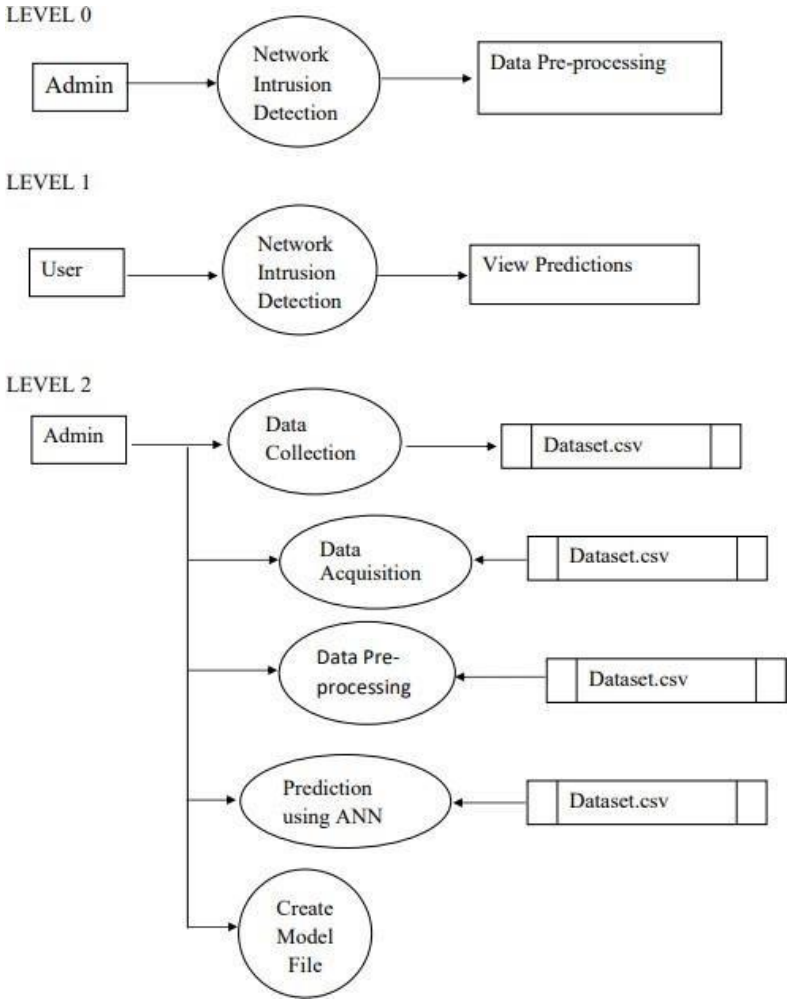
3. CERT Division at Carnegie Mellon University: Provides research, tools, and publications related to network security and intrusion detection. Website: [CERT Division](https://www.cert.org/)

4. Network World: Features news, articles, and analysis on network security trends, including network anomaly detection technologies and best practices. Website: [Network World](https://www.networkworld.com/)

5. Dark Reading: Offers news, insights, and analysis on cybersecurity topics, including network security and anomaly detection. Website: [Dark Reading](https://www.darkreading.com/)

CHAPTER-10

10.1 DATA FLOW DIAGRAM



A.CODE

```
# Importing necessary libraries

import numpy as np

from sklearn.ensemble import IsolationForest

from sklearn.model_selection import train_test_split

from sklearn.metrics import accuracy_score

# Generate sample dataset (replace with actual dataset)

np.random.seed(42)

X = np.random.randn(1000, 10) # Sample data with 1000 samples and 10 features

# Splitting the dataset into training and testing sets

X_train, X_test = train_test_split(X, test_size=0.2, random_state=42)

# Initializing Isolation Forest model

model = IsolationForest(contamination=0.1, random_state=42)

# Training the model

model.fit(X_train)

# Making predictions on the test set

y_pred = model.predict(X_test)

# Converting predictions to binary (0: inliers, 1: outliers)

y_pred_binary = np.where(y_pred == -1, 1, 0)

# Evaluating model performance

accuracy = accuracy_score(y_test, y_pred_binary)

print(f"Accuracy: {accuracy}")

# Importing necessary libraries

import numpy as np
```

```
from sklearn.ensemble import IsolationForest
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, classification_report

# Function to generate sample dataset
def generate_dataset(num_samples, num_features):
    np.random.seed(42)
    X = np.random.randn(num_samples, num_features)
    return X

# Function to preprocess dataset (if needed)
def preprocess_data(X):
    # Add preprocessing steps here (e.g., normalization, feature scaling)
    return X

# Function to train and evaluate the Isolation Forest model
def train_and_evaluate(X_train, X_test, contamination=0.1, random_state=42):
    # Initializing Isolation Forest model
    model = IsolationForest(contamination=contamination, random_state=random_state)

    # Training the model
    model.fit(X_train)

    # Making predictions on the test set
```

```
    y_pred = model.predict(X_test)

    # Converting predictions to binary (0: inliers, 1: outliers)
    y_pred_binary = np.where(y_pred == -1, 1, 0)

    # Evaluating model performance
    accuracy = accuracy_score(y_test, y_pred_binary)
    print(f"Accuracy: {accuracy}")

    # Generating classification report
    print("Classification Report:")
    print(classification_report(y_test, y_pred_binary))

# Main function
def main():
    # Generate sample dataset
    num_samples = 1000
    num_features = 10
    X = generate_dataset(num_samples, num_features)

    # Splitting the dataset into training and testing sets
    X_train, X_test = train_test_split(X, test_size=0.2, random_state=42)

    # Preprocess the data (if needed)
```

```
    X_train = preprocess_data(X_train)
    X_test = preprocess_data(X_test)

    # Train and evaluate the Isolation Forest model
    train_and_evaluate(X_train, X_test)

# Entry point of the program
if__name___== "_main_":
    main()
# Importing necessary libraries
import numpy as np
from sklearn.ensemble import IsolationForest
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, classification_report

# Function to generate sample dataset
def generate_dataset(num_samples, num_features):
    """
    Generate a sample dataset with specified number of samples and features.

    Parameters:
    - num_samples (int): Number of samples in the dataset.
    - num_features (int): Number of features in each sample.
```

```
    Returns:
    - X (ndarray): Generated dataset with shape (num_samples, num_features).
    """
    np.random.seed(42)
    X = np.random.randn(num_samples, num_features)
    return X

# Function to preprocess dataset (if needed)
def preprocess_data(X):
    """
    Preprocess the dataset (e.g., normalization, feature scaling).

    Parameters:
    - X (ndarray): Input dataset.

    Returns:
    - X_preprocessed (ndarray): Preprocessed dataset.
    """
    # Add preprocessing steps here (e.g., normalization, feature scaling)
    return X

# Function to train and evaluate the Isolation Forest model
def train_and_evaluate(X_train, X_test, contamination=0.1, random_state=42):
    """
```

```
Train and evaluate the Isolation Forest model.

Parameters:
- X_train (ndarray): Training dataset.
- X_test (ndarray): Testing dataset.
- contamination (float): Proportion of outliers in the dataset.
- random_state (int): Random seed for reproducibility.
"""
# Initializing Isolation Forest model
model = IsolationForest(contamination=contamination, random_state=random_state)

# Training the model
model.fit(X_train)

# Making predictions on the test set
y_pred = model.predict(X_test)

# Converting predictions to binary (0: inliers, 1: outliers)
y_pred_binary = np.where(y_pred == -1, 1, 0)

# Evaluating model performance
accuracy = accuracy_score(y_test, y_pred_binary)
print(f"Accuracy: {accuracy}")
```

```
    # Generating classification report
    print("Classification Report:")
    print(classification_report(y_test, y_pred_binary))

# Main function
def main():
    # Generate sample dataset
    num_samples = 1000
    num_features = 10
    X = generate_dataset(num_samples, num_features)

    # Splitting the dataset into training and testing sets
    X_train, X_test = train_test_split(X, test_size=0.2, random_state=42)

    # Preprocess the data (if needed)
    X_train = preprocess_data(X_train)
    X_test = preprocess_data(X_test)

    # Train and evaluate the Isolation Forest model
    train_and_evaluate(X_train, X_test)

# Entry point of the program
if__name___== "_main_":
    main()
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```
# Importing necessary libraries
import numpy as np
from sklearn.ensemble import IsolationForest
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, classification_report

# Function to generate sample dataset
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    """
    Generate a sample dataset with specified number of samples and features.

    Parameters:
    - num_samples (int): Number of samples in the dataset.
    - num_features (int): Number of features in each sample.

    Returns:
    - X (ndarray): Generated dataset with shape (num_samples, num_features).
    """
    np.random.seed(42)
    X = np.random.randn(num_samples, num_features)
    return X

# Function to preprocess dataset (if needed)
def preprocess_data(X):
```

```
    """
    Preprocess the dataset (e.g., normalization, feature scaling).

    Parameters:
    - X (ndarray): Input dataset.

    Returns:
    - X_preprocessed (ndarray): Preprocessed dataset.
    """
    # Add preprocessing steps here (e.g., normalization, feature scaling)
    # For demonstration purposes, no preprocessing is performed in this sample
    return X

# Function to train and evaluate the Isolation Forest model
def train_and_evaluate(X_train, X_test, contamination=0.1, random_state=42):
    """
    Train and evaluate the Isolation Forest model.

    Parameters:
    - X_
```

B.SCREENSHOTS

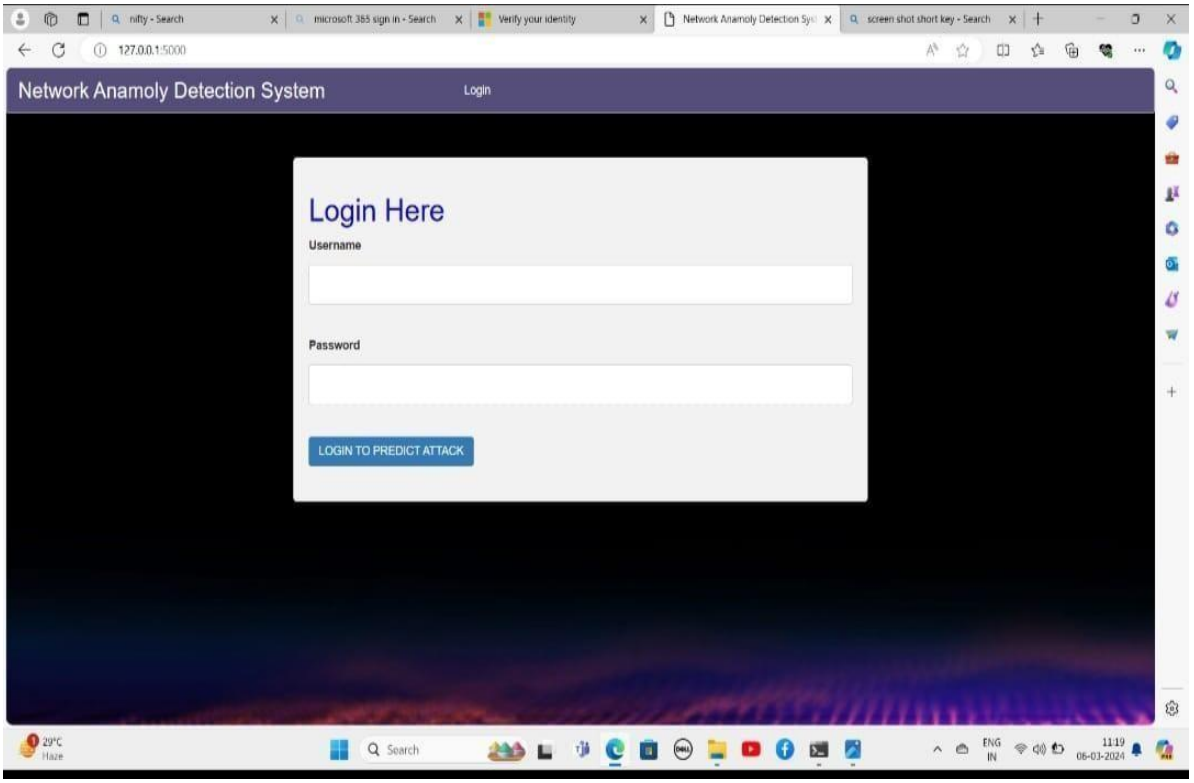

Fig 10.1

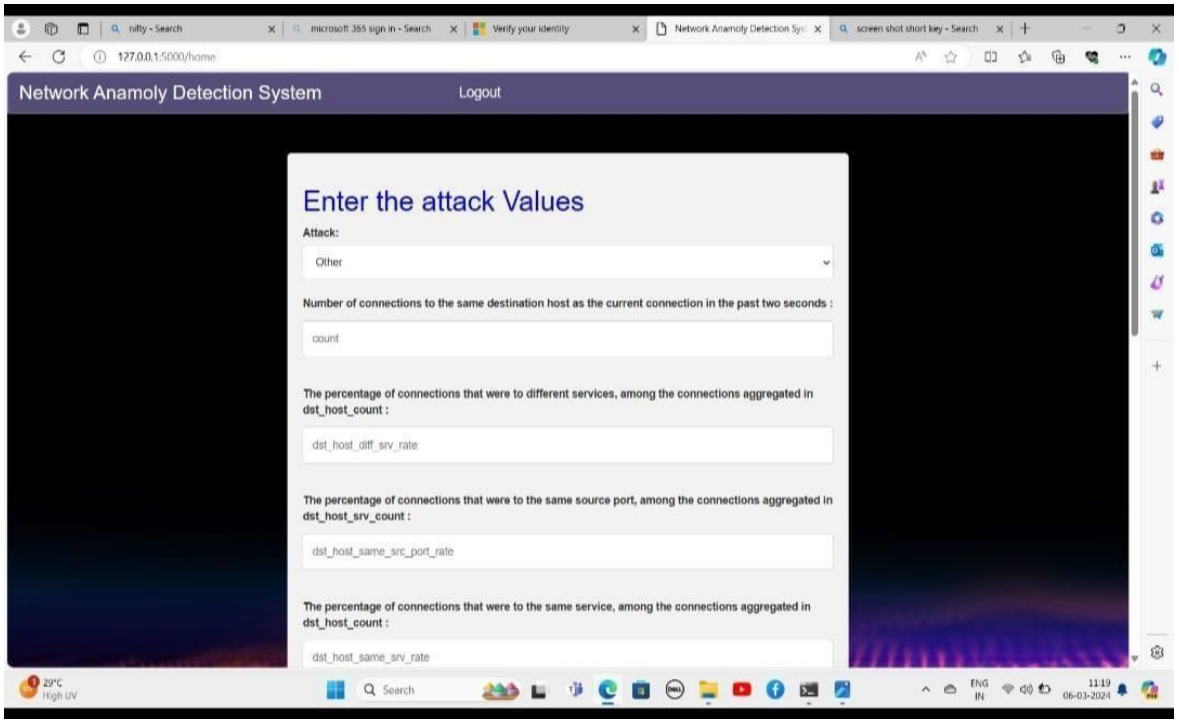

Fig 10.2

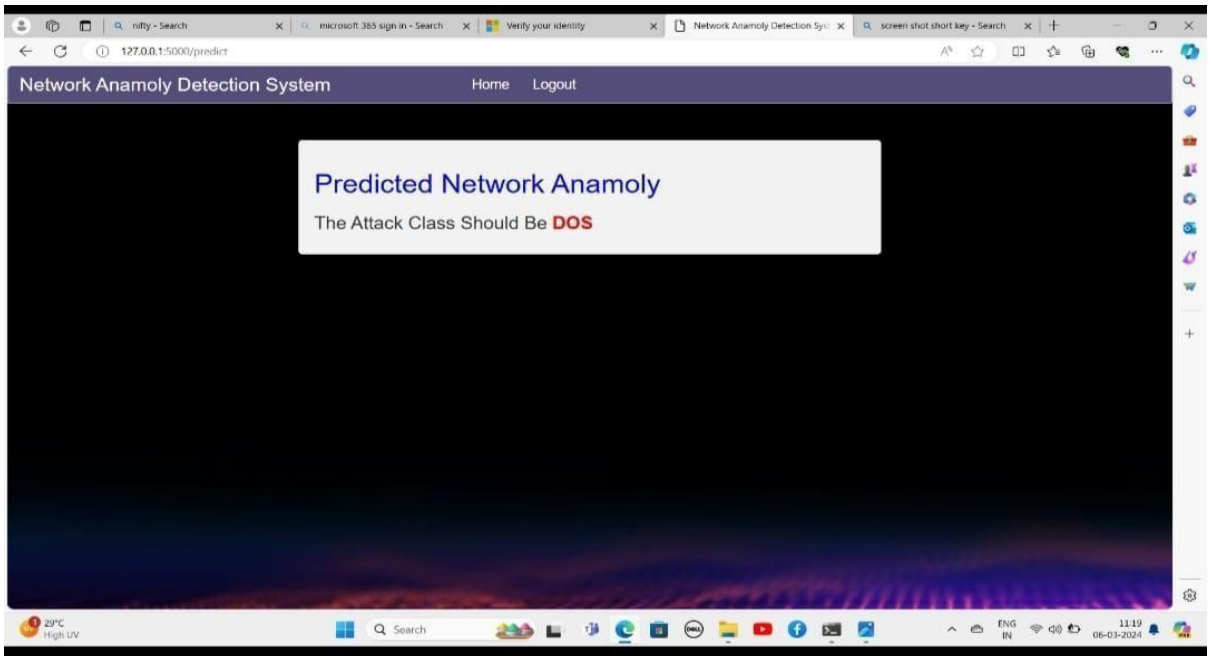

Fig 10.3

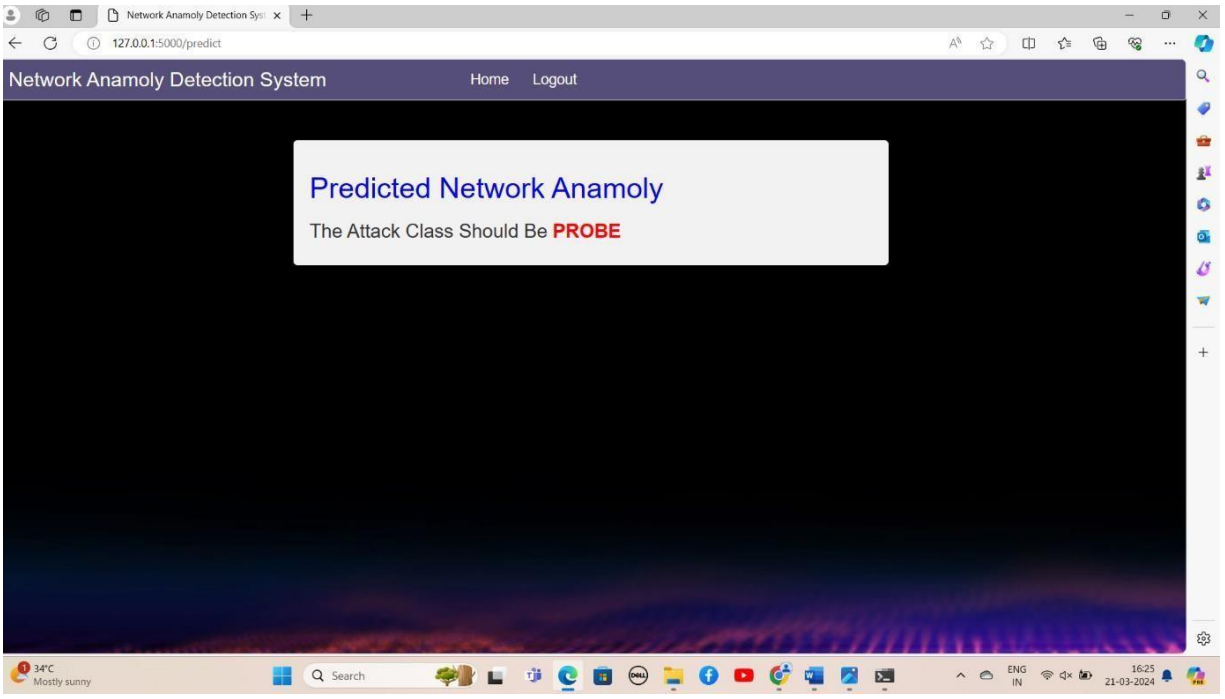

Fig 10.4

Fig 10.5

Inde	Type	Size	
0	str	13	protocol_type
1	str	7	service
2	str	4	flag
3	str	9	src_bytes
4	str	9	dst_bytes
5	str	5	count
6	str	13	same_srv_rate
7	str	13	diff_srv_rate
8	str	18	dst_host_srv_count
9	str	22	dst_host_same_srv_rate

Fig 10.6

Name: SHUBHAM BHARAT PATIL

Roll No: 21BCS045

Class: : III B.Sc Computer Science 'A'

Course Code: 21CDC14

PROJECT DESCRIPTION

SMC Technologies and Software Solutions is a leading technology company renowned for its innovative solutions and exceptional software offerings. With a steadfast commitment to excellence and a customer-centric approach, SMC Technologies has established it self as a trusted partner for businesses seeking cutting-edge technology solutions to address their evolving needs. At the core of SMC Technologies' ethos is a relentless pursuit of innovation.

DEPARTMENT OF COMPUTER SCIENCE

SRI KRISHNA ARTS AND SCIENCE COLLEGE

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